What is a Living Shoreline?
Living Shoreline Fundamentals

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VIMS | William & Mary
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Center for Coastal Resources Management
Virginia Institute of Marine Science

Living Shoreline Fundamentals

- Origins of Living Shoreline Initiative
- Main Guiding Principles
- Living Shoreline Types

ORIGINS OF LIVING SHORELINE INITIATIVE

The Preferred Alternative for Shorelines is a Natural Condition

Preserve riparian forests & wetlands as much as possible

Manage land uses to minimize risk from flooding & erosion

Yet the Common Choices for Shorelines Include…

Development close to the water

Waterfront lawns & shoreline protection structures

Shoreline Hardening

The installation of multiple bulkheads and revetments along the shoreline that “hardens” previously natural shoreline conditions.

Each individual project may seem insignificant by itself
but the combined miles of many hard structures across time & space
has cumulative impacts on entire estuary

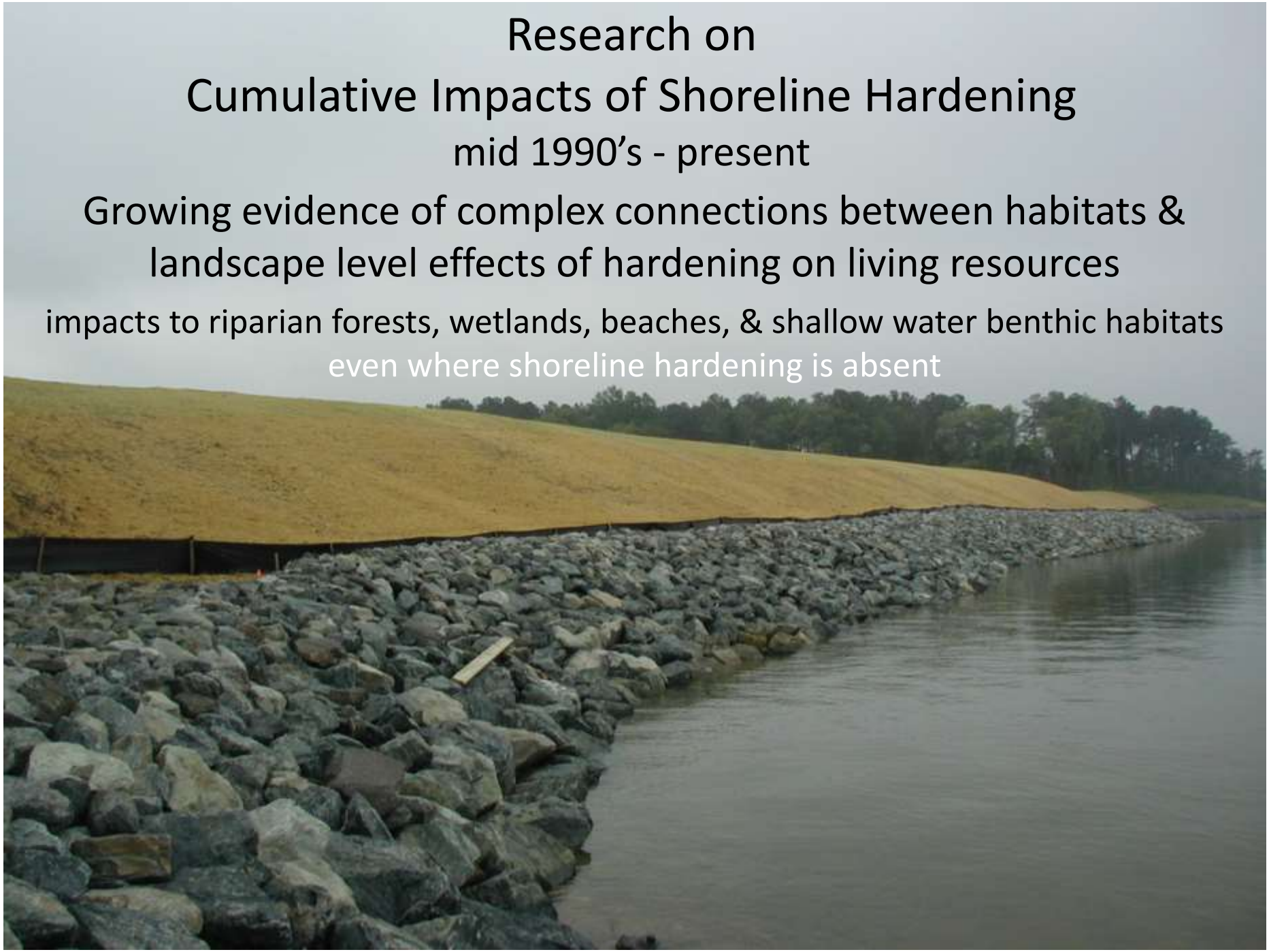
Research on
Cumulative Impacts of Shoreline Hardening

mid 1990's - present

Growing evidence of complex connections between habitats & landscape level effects of hardening on living resources

impacts to riparian forests, wetlands, beaches, & shallow water benthic habitats

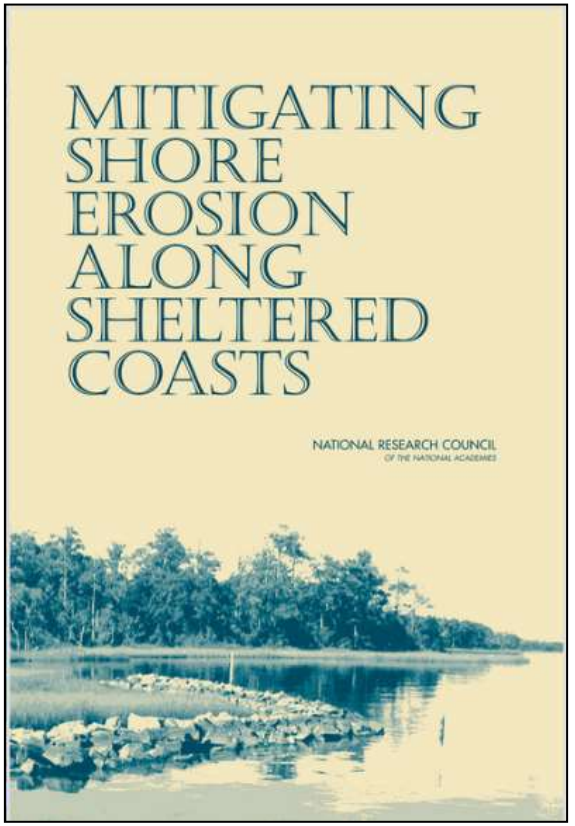
even where shoreline hardening is absent



Cumulative Impacts of Shoreline Hardening

- Habitat loss & fragmentation
  - Decreased habitat diversity
- Sediment supply & transport altered
  - Increased scour & turbidity
- Increase in invasive species
- Decrease in fish & benthos # & diversity
- Decrease in marsh bird diversity
- Habitat migration interrupted
- Evidence of low thresholds
  - Some adverse effects noticed @ 5% hardening
  - Even more when hardening reaches >15%

For More Information



National Research Council, 2007

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Delaware Shoreline Inventory

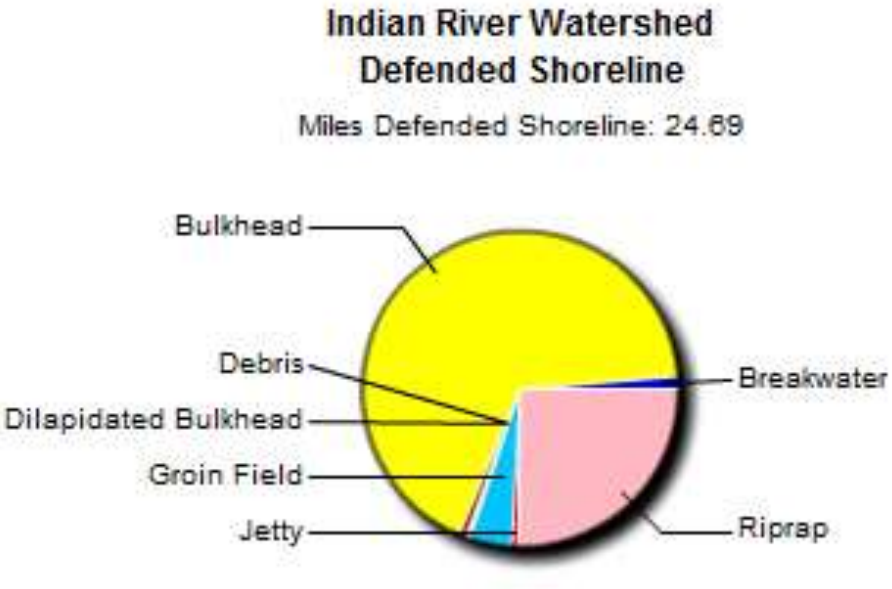
Completed in 3 phases to map shoreline conditions in select watersheds 2005 - 2007 - 2012

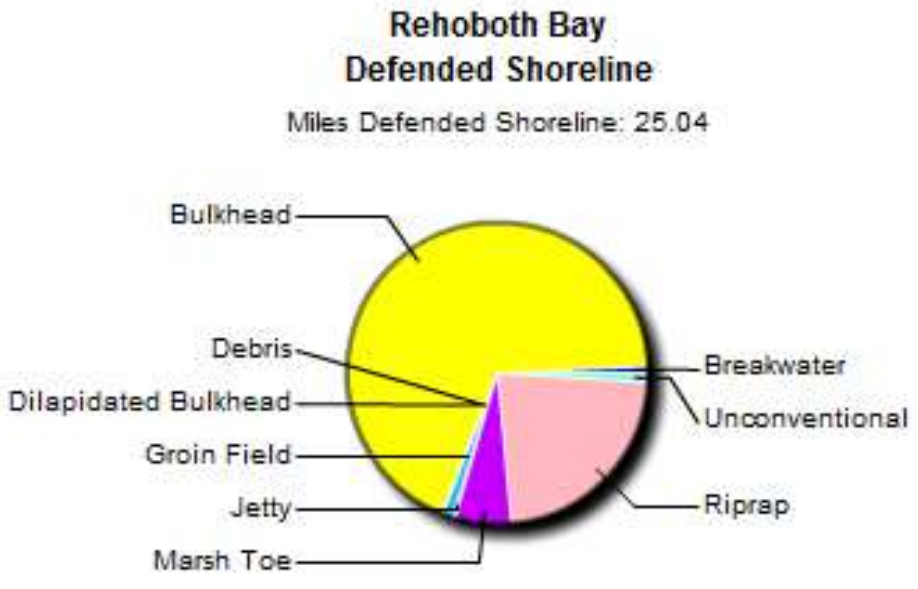
Shoreline Protection Structures

- Breakwater
- Bulkhead
- Debris
- Dilapidated Bulkhead
- Groin Field
- Jetty
- Marsh Toe Revetment
- Riprap
- Unconventional

Defended Shorelines by River System

Coastal Bays





2006 data

2012 data

23 miles bulkhead + riprap
120 miles surveyed

19% hardened shoreline

23 miles bulkhead + riprap
148 miles surveyed

15.5% hardened shoreline

Origin of "Living Shorelines"

- Not New - 'Vegetative Stabilization' developed in 1970's has been preferred alternative for low energy, minor erosion problem solving *but not widely practiced when appropriate*
- 2004 new initiative started in Maryland & Virginia
  - to re-invigorate interest in **low impact stabilization**
- Fueled by data from cumulative impact analyses & scientific research of hardened shorelines
  - Annual miles of shoreline hardening
  - Net tidal wetland loss compared to mitigation acres

'Living Shorelines' described new initiative

Coastal States with Living Shoreline Programs

due to concerns for shoreline hardening trend

- Northeast
  - Connecticut
  - Rhode Island
  - New York
  - New Jersey
  - **Delaware**
- Mid-Atlantic & Southeast
  - Maryland
  - Virginia
  - North Carolina
  - Florida
- Gulf Coast
  - Alabama
  - Mississippi
  - Texas
- West & Northwest
  - California
  - Oregon
  - Washington
- Great Lakes
  - Michigan
  - Ohio
  - New York

MAIN GUIDING PRINCIPLES

What are Living Shorelines for Erosion Protection?

Alternatives for bulkheads & revetments

Where erosion cannot be tolerated &

some type of action is necessary

Mimic &/or protect existing coastal habitats

Upland — Riparian Buffers

Wetland — Tidal Marshes Sand Beaches

Shallow Water — Shellfish Reefs Submerged Aquatic Vegetation

Common Elements in Living Shoreline Definitions

- **Erosion risk reduction** – unacceptable erosion risk is present and some type of shoreline management action is necessary
- **Wave attenuation** – rough surfaces to reduce wave height and energy of approaching waves
- **Habitat heterogeneity** – Diverse habitats similar to natural shorelines in local area
- **Habitat continuum** – unimpeded migration of fish and wildlife along the shoreline and between aquatic and terrestrial habitats, flow of energy, organic matter, & food between habitats
- **Habitat dynamics & migration** – habitat features can shift in response to sea level rise, vertical sediment accretion

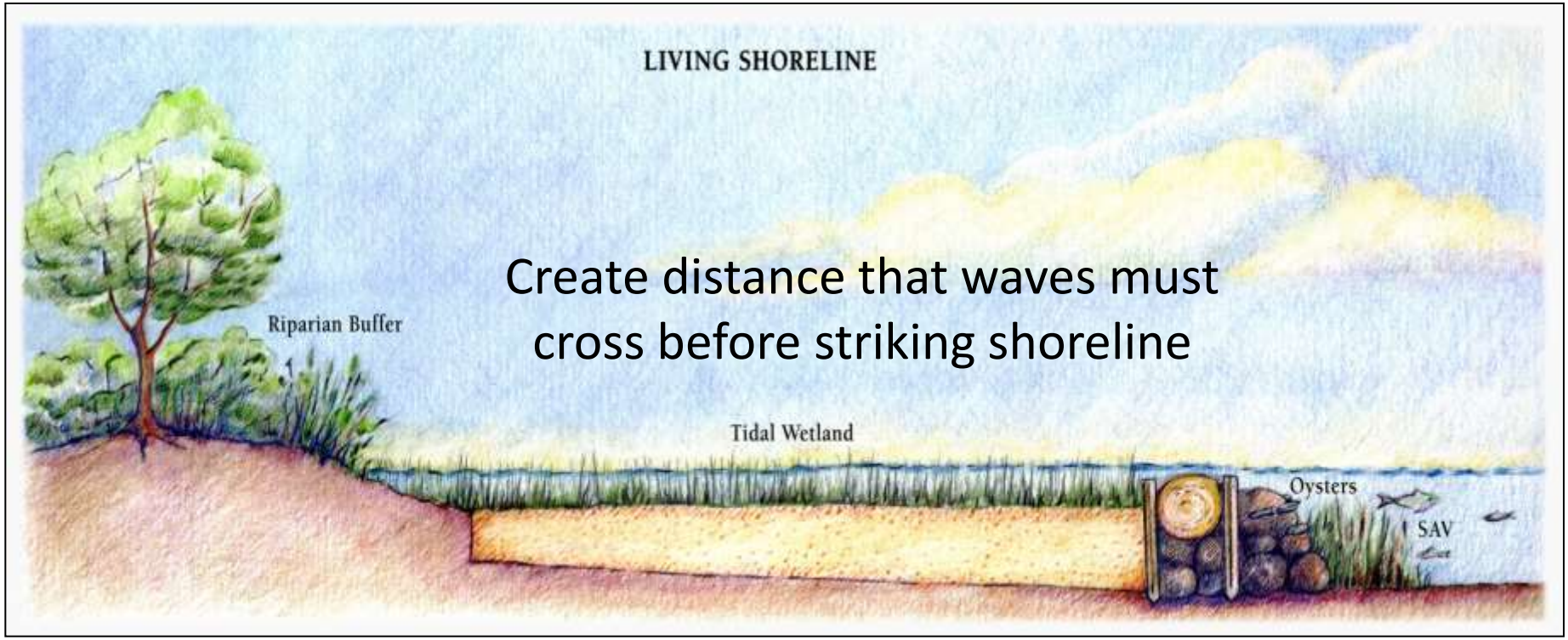
Source: Bilkovic, Mitchell, Mason & Duhring, 2016 in press

Living Shorelines for Upland Bank Erosion

Vegetation is dominant – Riparian Buffer + Wetland

Bank Grading & Sand create suitable slopes & elevations

Stone & Structures **are minor elements to support vegetation & sand**



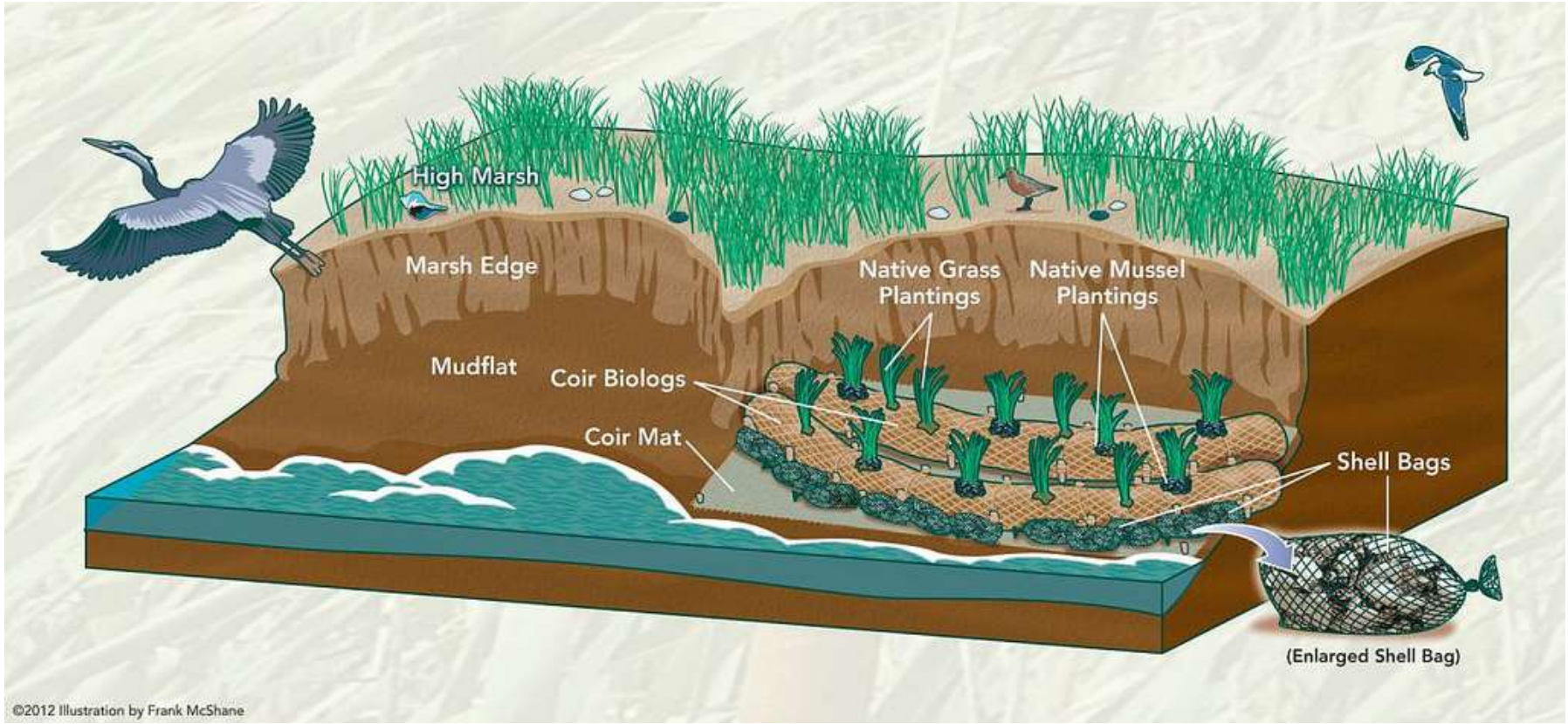
Graphic Source: Chesapeake Bay Foundation

Living Shorelines for Marsh Edge Erosion

Help stabilize erosion & increase vertical sediment accretion

Natural marsh shoreline

Living Shoreline Treatment



Graphic courtesy of the Partnership for the Delaware Estuary & DNREC

What's the Difference?

Habitat Restoration
Wetland Mitigation

Main purpose is to create & replace lost natural habitat for its intrinsic value

Human presence minimal if not absent

Living Shorelines

Main purpose is usually to solve a problem for people

- Erosion
- Sediment contamination
- Beneficial use of dredged material

Manipulated, engineered designs

Human presence normal

May or may not match natural communities exactly

Ecological Uplift – Net Benefits – Work With Nature

3 yr old living shoreline marsh

- Reduce erosion
- Filter pollutants to improve water quality
- Connect animals to critical nursery areas
- Increase number & types of fish and wildlife
- Less constraints, dynamic sand & soil movement
- Do No Harm to ecologically valuable habitats

Shoreline Erosion vs. Tidal Flooding

Erosion protection structures typically do not reduce flooding risk

Different adaptations are necessary for flood prone properties

Elevating houses & roads

Fill material to raise elevation

Retreat from shoreline

Effective Storm Protection

depends on structural integrity & land use risk factors

Most projects are designed for low intensity storms

Not all bulkheads and revetments remain intact after being overtopped by storm waves

Living Shorelines
are usually submerged during storm events
yet are effective & resilient

Because the wave energy reaching the upland is reduced

Learn more about this later from Doug Janiec's presentation

Virginia living shoreline project during Veterans Day Nor'Easter 2009

Same well-established living shoreline marsh the day after Hurricane Irene 2011

LIVING SHORELINE TYPES

Living Shoreline Project Categories

Non-Structural

Vegetative Stabilization
Sand Fill

Gradual Slopes

Hybrid

Engineered structures required to support living habitat components & achieve desired level of protection

Non-Structural Approaches

Riparian Buffer Planting

Grade Bank &
Restore Riparian Buffer

Planted Marshes & Fiber Logs

Beach Nourishment
& Planted Dunes

Non-Structural Project Example @ Lewes Canal

Non-Structural Project Example @ Blackbird Creek Reserve

Hybrid Living Shoreline Structure Types

- Rock
  - Marsh sills, marsh toe revetments, breakwaters
- Pre-fabricated Concrete Materials
  - Shoretec (& other) Vegetation Cells
  - Wave Attenuation Devices (WAD)
  - Oyster Castles, Reef Balls, Ready Reef, Reef Blok (& others)

Hybrid Approach
Shellfish Reef Structures or Biogenic Reefs

Bagged Shell

'Reef Balls'

'Oyster Castles'

'Ready Reef'

Hybrid Project Example @ Mispillion Harbor

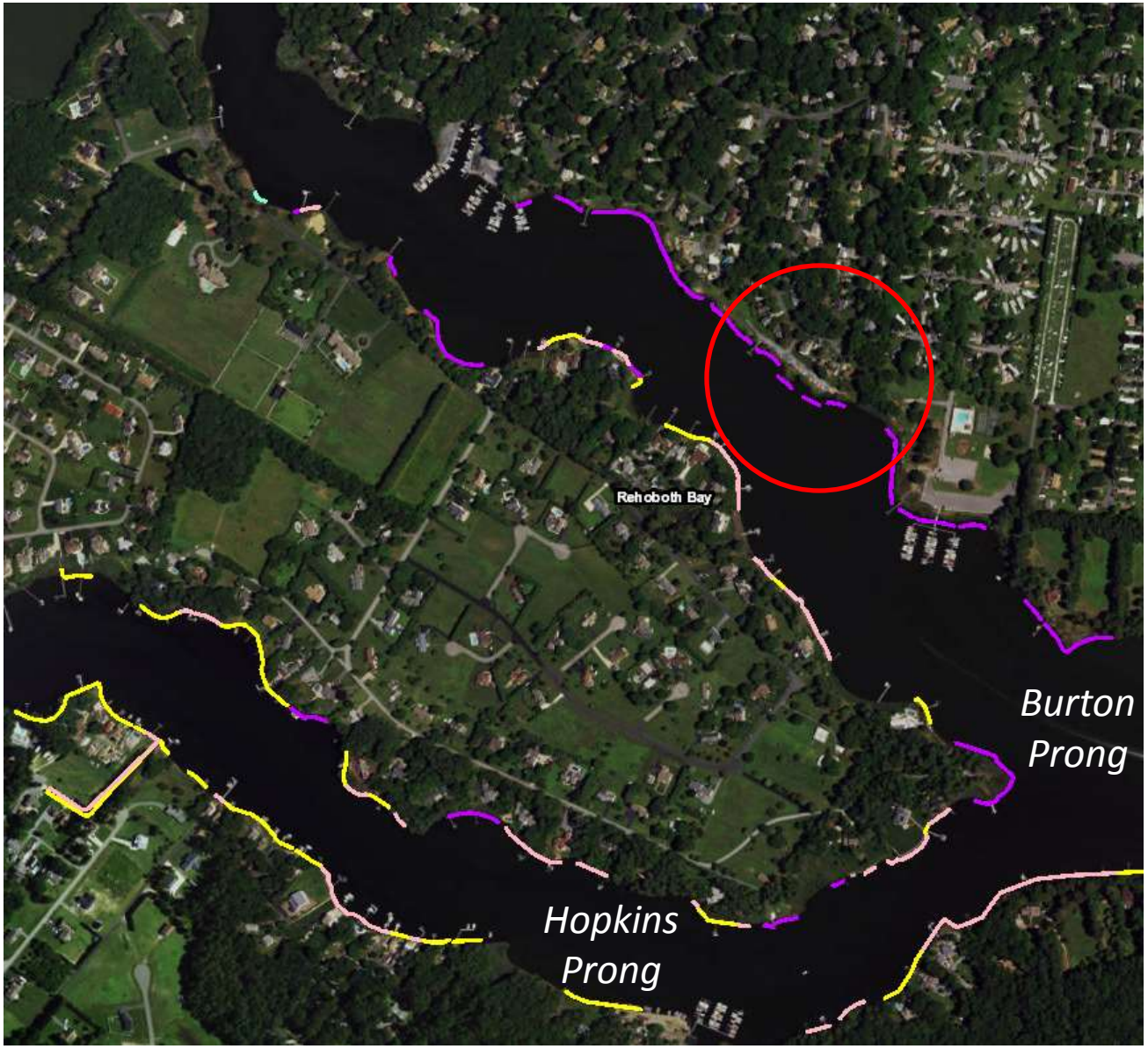
Reinforcement with Oyster Castles & Oyster Shell Bags

Marsh Sill

A low-profile revetment backfilled with sand to create & support planted tidal marsh

Similar Term – Marsh Toe Revetment @ natural marsh edge

Rehoboth Bay Shoreline Inventory



Marsh Sills

Marsh Sills @ Elmwood Avenue Lewes, DE

Living Shoreline Fundamentals

Summary

- **Nationwide Living Shoreline Initiative**
  - Re-invigorate interest in low impact shoreline stabilization
  - Bring attention to growing evidence of harm caused by shoreline hardening
- **Main guiding principles** include:
  - Solve problems for people
  - Mimic dynamic natural habitats
  - Achieve ecological uplift, do no harm to valuable coastal habitats
- **Two project types**
  - Non-structural mostly organic
  - Hybrid with supporting structures to achieve desired level of protection

Questions About the Fundamentals?

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